Semiconductor Processors

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What They Do

Semiconductor Processors manufacture electronic semiconductors (known as computer chips, microchips, or integrated circuits) in disks of varying sizes, generally eight to twelve inches wide. These disks, called wafers, are thin slices of silicon on which the circuitry of the microchips is layered. Each wafer is eventually cut into dozens or scores of individual chips.

Semiconductor Processors make wafers by means of photolithography, a printing process for creating patterns from photographic images. Operating automated equipment, processors imprint precise microscopic patterns of the circuitry on the wafers, etch out the patterns with acids, and replace the patterns with metals that conduct electricity. Then, the wafers receive a chemical bath to make them smooth, and the imprint process begins again on a new layer with the next pattern. Wafers usually have from 8 to 20 such layers of microscopic, three-dimensional circuitry. Technicians troubleshoot production problems and maintain equipment.

Semiconductors are produced in semiconductor fabricating plants, or "fabs." Within fabs, the manufacture and cutting of wafers to create semiconductors takes place in "cleanrooms," production areas that must be kept free of any airborne matter, because the least bit of dust can damage a semiconductor.

Tasks

- Align photo mask pattern on photoresist layer, expose pattern to ultraviolet light, and develop pattern, using specialized equipment.
- Attach ampoule to diffusion pump to remove air from ampoule, and seal ampoule, using blowtorch.
- Calculate etching time based on thickness of material to be removed from wafers or crystals.
- Clean semiconductor wafers using cleaning equipment, such as chemical baths, automatic wafer cleaners, or blow-off wands.
- Etch, lap, polish, or grind wafers or ingots to form circuitry and change conductive properties, using etching, lapping, polishing, or grinding equipment.
- Load and unload equipment chambers and transport finished product to storage or to area for further processing.
- Locate crystal axis of ingot, and draw orientation lines on ingot, using x-ray equipment, drill, and sanding machine.

*Detailed descriptions of this occupation may be found in the Occupational Information Network (O*NET) at online.onetcenter.org.*

Employment Development Department State of California
LMID Labor Market Information Division "Your Information Source"

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Important Skills, Knowledge, and Abilities

- Production and Processing — Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Operation and Control — Controlling operations of equipment or systems.
- Operation Monitoring — Watching gauges, dials, or other indicators to make sure a machine is working properly.
- Science — Using scientific rules and methods to solve problems.
- Equipment Selection — Determining the kind of tools and equipment needed to do a job.
- Control Precision — The ability to quickly and repeatedly adjust the controls of a machine or a vehicle to exact positions.
- Information Ordering — The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

Work Environment

All Semiconductor Processors working in cleanrooms (both Operators and Technicians) must wear special lightweight outer garments known as "bunny suits." These garments fit over clothing to prevent lint and other particles from contaminating semiconductor-processing worksites. The measures taken to avoid contamination of the wafers create exceptionally clean environments, nearly free of contaminants that could cause occupational illnesses and accidents. The temperature in the cleanrooms must be kept within narrow ranges, usually a comfortable 72 degrees Fahrenheit. Entry and exit of workers in bunny suits from the cleanroom is controlled to minimize contamination, and workers must be re-clothed in a clean suit and decontaminated each time they return to the cleanroom.

The work pace in cleanrooms is deliberately slow to keep the air in cleanrooms as free as possible of dust and other particles. Although workers spend some time alone monitoring equipment, Operators and Technicians spend much of their time working in teams.

Technicians are on their feet most of the day, walking through the cleanroom to oversee production activities. Operators spend a great deal of time sitting or standing at workstations, monitoring computer readouts and gauges. Sometimes they must retrieve wafers from one station and take them to another.

Some semiconductor fabricating plants operate around the clock, so night and weekend work is common. Hours and shifts vary with different employers. Some plants operate eight-hour shifts, five days a week. While other plants operate 12-hour shifts to reduce the disruption of cleanroom operations.

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California's Job Outlook and Wages

The California Outlook and Wage table below represents the occupation across all industries.

Standard Occupational Classification	Estimated Number of Workers 2004	Estimated Number of Workers 2014	Average Annual Openings	2006 Wage Range (per hour)
Semiconductor Processors				
51-9141	10,800	11,400	300	$13.41 to $21.62

Wages do not reflect self-employment.
***Average annual openings** include new jobs plus net replacements.*
Source: www.labormarketinfo.edd.ca.gov, Employment Projections by Occupation and OES Employment & Wages by Occupation, Labor Market Information Division, Employment Development Department.

Trends

Growth of the occupation, Semiconductor Processors, will be slower than average compared to all California occupations. Many companies in the United States are building plants overseas where costs are lower and downsizing their operations in our country. Despite the expected decline in employment of Semiconductor Processors, the demand for semiconductor chips remains very high stemming from the many existing and future applications for semiconductors. Job prospects will be best for people with postsecondary education in electronics or semiconductor technology.

Training/Requirements/Apprenticeships

A high school diploma or equivalent is the minimum requirement for entry-level operator jobs in semiconductor fabrication plants. However, employers increasingly prefer persons who have completed associate degree programs for semiconductor processor jobs.

Semiconductor technology programs in a growing number of community colleges include an internship at a semiconductor fabricating plant. Many students in these programs already hold full-or part-time jobs in the industry. In their spare time, many work toward degrees in semiconductor technology to update their skills or qualify for promotion to technician jobs. In addition, to ensure that operators and technicians keep their skills current, many employers provide 40 hours of formal training annually. Some employers also provide financial assistance to employees who want to earn associate and bachelor's degrees.

Recommended High School Course Work

High school students interested in this kind of work should take mathematics and the physical science courses.

Where Do I Find the Job?

Direct application to employers remains one of the most effective job search methods. Use the *Search for Employers by Industry* feature on the *Career Center* page at www.labormarketinfo.edd.ca.gov to locate employers in your area. Search using keywords from the following manufacturing industry names to get a list of private firms and their addresses:

- Bare Printed Circuit Board
- Computer Storage Device
- Electronic Computer
- Electronic Connector

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- Computer Terminal
- Computer Wholesale
- Electron Tube
- Electronic Capacitor
- Electronic Coils, Transformer and Inductor
- Electronic Resistor
- Other Computer Peripheral Equipment
- Other Electronic Component
- Semiconductor and Related Devices

Search these **yellow page** headings for listings of private firms:

- Cellular and PCs Equipment/Supplies
- Computer Service and Repair
- Computer Supplies and Parts
- Computer Wholesale
- Semiconductor Devices
- Semiconductor Manufacturers
- Telecommunications Services
- Wireless Data Services and Products

Where Can the Job Lead?

Semiconductor Processors start as operators and advance to technician. Beyond technician, opportunities for advancement are limited. Those that demonstrate ability and skill may advance to a supervisory-level position. Some Semiconductor Processor Technicians transfer to sales engineer jobs with suppliers of the machines that manufacture the semiconductors or become field support personnel.

Other Sources of Information

Semiconductor Industry Association
www.sia-online.org

Maricopa Advanced Technology Education Center
www.matec.org

SEMATECH
www.sematech.org